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Known Harmful Effects Of Constituents of Jet Oil Smoke

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ABSTRACT
The construction of cabin pressurization systems of certain commercial aircraft allows pyrolyzed jet oil to leak into the cabin air, often producing visible smoke. The principal toxic constituents of this smoke are tricresyl phosphate, carbon monoxide, and N-phenyl-L-naphthylamine. Long-term neurological effects alleged by airline workers could be due to tricresyl phosphate and/or carbon monoxide exposure.

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Generation and Constituents of Jet Oil Cabin Smoke

The BAe-146 aircraft uses precombustion air from the jet engines to pressurize the cabin. At the point at which it is bled off, the air is at a temperature of approximately 500 °C. Failing oil seals can permit leakage of jet oil into the air prior to its being bled off (1). Catalytic converters are designed to remove pollutants, but are insufficient in the event of a seal failure; smoke can often be observed in the cabin (1). A number of complaints have been made by personnel working on these commercial aircraft of long-term neurological effects. Investigations of jet oils under simulated pyrolysis conditions found tricresyl phosphates and Carbon monoxide (CO), as well as some Carbon dioxide (CO_2); trimethyl propane phosphate, Nitrogen dioxide (NO_2) and Hydrogen cyanide (HCN) were not found (1). Other potential constituents were not specifically addressed.

Tricresyl Phosphate

Tricresyl phosphate (CAS 1330-78-5) is a mixture of isomers, with the primary toxic form being the ortho isomer; formulations made in recent decades have had decreased levels of the toxic isomer (2). Studies using oral dosing suggest that current formulations have a fairly high threshold to produce an acute effect: doses of up to 2 grams per kilogram of organism did not produce any lasting neurological effects (2, 3, 4). It should be noted that route of administration can be important in the dose required to see an effect from toxic substances; no completed studies on inhalation of jet engine oils or tricresyl phosphate were available. One study which assessed the impact of orally-administered jet engine oil on enzyme activities in the brains of hens found that significant differences occurred in brain chemistry between six weeks exposure when no effect was seen, and 13 weeks, when a 23 to 34% enzyme inhibition could be detected (4). Another study, using dermal exposure in cats, found that exposure levels that did not

initially cause an effect began causing typical organophosphate poisoning effects after an initial exposure period, and that this period was itself dose-dependant (5). Therefore, doses below the recognized threshold for acute exposure could cause an organophosphate-type poisoning if the exposure was long in duration. Tricresyl phosphate also causes a dramatic decrease in fertility in male rats, but not in females (6).

CARBON MONOXIDE

Carbon monoxide (CO) was also produced under simulated oil leak conditions, at levels up to 100 ppm (1). Acute exposure to CO produces headache, dizziness, and nausea; long term exposure can cause memory defects and central nervous system damage, among other effects (7). Mice repeatedly exposed to CO exhibit neurodegeneration in the hippocampal region of the brain, and experience marked learning deficits (8). While most study regarding CO focuses on high exposure levels, some studies on lower exposures (0.28 to 2.8 ppm, 100 ppm) have shown a potential mechanism for oxidative damage to mammalian systems at these exposure levels: release of nitric oxide and the production of a toxic metabolite, peroxynitrite (9, 10).

N-PHENYL-1-NAPHTHYLAMINE

N-phenyl-1-naphthylamine (PAN; CAS # 90-30-2) is an antioxidant most often used in rubber formulations. It is readily absorbed by mammalian systems and rapidly converted to metabolites (11). Most toxicological studies focus on its potential carcinogenicity. One study, using both PAN and the related compound N-phenyl-2-naphthylamine administered subcutaneously to mice found a heightened incidence of lung and kidney cancers (12). A high incidence of various forms of cancer was also found among workers exposed to antirust oil containing PAN (13).

NEUROLOGICAL EFFECTS SUMMARY

Both tricresyl phosphate and CO have been suggested to cause long-term neurological complications. From the available data, the only potential neurological effect of the naphthylamines would be oncological, but there is no evidence to suggest a connection between PAN and brain tumor formation.

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